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International Journal of Multiphase Flow 31 (2005) 53–68
International Journal of Multiphase Flow
www.elsevier.com/locate/ijmulflow

Hydrodynamically interacting droplets at small Reynolds numbers

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Received 12 February 2004; received in revised form 6 September 2004

Abstract

Droplets moving at close distances interact hydrodynamically. We present the experimental and theoretical results of a study for monodisperse 73 μm geometric diameter droplets with initial velocities between 1.5 and 3 m/s and variable generation rate (ranging from 125 to 2000 s^{-1}) emitted horizontally and vertically. During the decelerated motion the droplet Reynolds number varied between the value <1 and 10. The hydrodynamic interaction depends on the spatial distance, and we observed a considerable increase of the droplet trajectory endpoints with increasing generation rate.

Reviewing the various approaches for the description of hydrodynamic interactions, we adapted a theory for a stationary Stokes flow past a linear array of spheres and found a surprisingly good agreement between our experiments and the above model. Even better agreement was obtained by additionally taking the Basset force into account.

Keywords: Droplet interaction; Drag correction; Basset force

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0301-9322/$ - see front matter
doi:10.1016/j.ijmultiphaseflow.2004.09.003